wrnch AI Pose Estimation extension for NVIDIA Omniverse

This wrnch extension package for NVIDIA Omniverse includes:

- **wrnch CaptureStream** - a free application that you can download to an iOS device or NVIDIA-GPU powered PC to perform markerless motion capture. As you capture human performance, the **wrnch Engine** detects humans in the video feed and uses powerful human pose estimation algorithms to track skeletal joints to infer human poses and motion. The wrnch Engine outputs 3D animation data using the wrnch eXchange (wrXchang) data protocol.

- **wrnch AI Pose Estimator extension** is an Omniverse extension. With the extension, you can search and find a wrnch CaptureStream application running on a local network. As the human pose data is transmitted to Omniverse in real time, the extension translates the wrXchang data stream into USD (Universal Scene Description) - a 3D description and format file developed by Pixar for content interchange - where it can be mapped to a 3D virtual character in Omniverse.
Discover how you can get up and running using the tools and extension to add life-like 3D characters to enhance your storytelling by completing the following steps.

1. **Set Up wrnch CaptureStream**
   a. **Set Up wrnch CaptureStream for iOS Devices**
   b. **Set Up wrnch CaptureStream Command Line Client for PCs**
2. **Set Up wrnch AI Pose Estimator extension for Omniverse**
3. **Stream AI Pose Data to Animate 3D Characters in Real Time**

### Set Up wrnch CaptureStream for iOS Devices

**wrnch CaptureStream** allows you to capture the human motion that you’d like to reproduce in an application.

**Pre-requisites:**

- **Supported devices:**
  - Apple iPhone XS/XR and later devices with A12 or later processors
  - Apple iPad 2019 or later
  - Platform/OS: Apple iOS 14 or later
- **Phone/Tablet mount; for example, tripod with iPhone adapter**

**Setup the wrnch CaptureStream application**

1. Download the [wrnch CaptureStream application from the AppStore](https://apps.apple.com) to capture and digitize human motion using just an iPhone or iPad.
2. Once you Open the application,
   a. Select OK to allow CaptureStream to find and connect to devices on your local network.
   b. Select OK to allow CaptureStream to access the camera to detect human poses.
3. Press Start, and toggle on “Pro Mode” to use the rear-facing camera.
4. In landscape orientation:
   a. Point the device at an angle towards the floor to establish a ground plane. Walk around, scanning the performance area. You will see a grid appearing as an overlay to the floor. Once the grid covers the area of the floor that the actor will perform on, click on the grid to select it. The grid will change from gray to blue.
   b. Make sure the blue grid that covers the floor includes all the space for your intended performance.
5. Wait up to 30 seconds while artificial intelligence for human pose estimation is loaded into the device.

### Setup the performance area for markerless motion capture
1. Choose a well-lit, clear space where an actor will perform the human that you want to mimic in your Omniverse application. Consider a size of about 10 feet x 10 feet (3m x 3m).

2. Mount the camera device in landscape orientation in a fixed position, for example on a tripod. The camera needs to stay still as you capture the performance area where the actor will move. Ensure that the mounted camera is far enough away from the performance space to ensure that you can capture the whole body of the actor.

3. Take a test video using the rear-facing camera to make sure it can see the entire performance.

Launch and calibrate the wrnch CaptureStream application

1. When you start wrnch CaptureStream, you are first asked to give permission for the application to access the device’s camera and network. Once you’ve done that, click Start on the landing screen.

2. On the launch screen, use the slider to select Pro Mode to calibrate and enable root motion. This enables you to maximize the fidelity of the performance capacity by tracking you as you move around the space. Click Next.

3. At this point, you need to inform CaptureStream about the floor of your performance space. Tilt the camera at a 45-degree angle to the floor and sweep it across the floor. CaptureStream will display a blue grid as it detects the floor and will then instruct you to position the camera in a stable position. Click Next.

4. Instruct an actor to walk into the scene from the side, facing sideways, to the central area of the performance so that CaptureStream can understand body size. As long as wrnch CaptureStream does not detect a face, the view looks similar to the following image.
5. To finalize initialization, ask the actor to hold an A-pose (arms out at an angle to each side while standing straight) while facing the camera. When CaptureStream has calibrated the body size, it turns green as shown in the following image.
At this point, CaptureStream is ready to stream 3D poses of the actor’s performance across your local network. Next you need to set up the wrnch AI Pose Estimator extension in Omniverse so that it can receive the human pose information.

Set Up wrnch CaptureStream Command Line Client for PC

The wrnch CaptureStream client (capturestream-cli) is a command line application that can run on any NVIDIA RTX GPU-powered personal computer (PC). You can access this application from the wrnch Developer Portal; registration is required.

With this application, developers can capture human motion using a Webcam attached to the PC. When CaptureStream is running, you will see the actor’s movements mimicked by an avatar, enabling you to capture the motion you want to transform into 3D animation in your application. The wrnch Engine detects humans in the video feed and uses powerful human pose estimation algorithms to track skeletal joints to infer human poses and motion. The wrnch engine output 3D pose data using the wrnch eXchange (wrXchng) data protocol to a receiving application such as:

- wrnch ReceiveVisualize for UE4
- wrnch ReceiveVisualize for Unity
- wrnch AI Pose Estimator extension for NVIDIA Omniverse (as shown in the Figure below).
About wrnch CaptureStream CLI for PC

wrnch CaptureStream CLI for PC has the following pre-requisites:

- **Supported devices:**
  - PC with NVIDIA GPU card (RTX 2070 or better) with 4GB+ of VRAM*
  - Platform/OS: Windows 10 or Ubuntu 18
- **RGB Webcam (Supported without any additional configuration)**
  - Logitech StreamCam
  - Logitech Brio Ultra HD Pro Webcam 4K
  - Logitech C922
  - Logitech C920 HD Pro Webcam
  - Razer Kiyo
- **Webcam mount**

Setup the Webcam
wrnch recommends that you use a supported high-resolution Web camera. If you are using an unsupported Webcam, adjust the horizontal field of view to 100 degrees.

Install wrnch Engine 2.x and wrnch CaptureStream CLI

1. Go to [www.wrnchai.com](http://www.wrnchai.com) and select Developer Portal button.
2. You will need to register to access the Developer Portal the first time. Enter your username or email address, your password, and Sign In.
3. From the left menu, select “Develop - wrnch Engine 2.x”. Scroll down and select either the wrEngine-Windows-2.1.1.exe or wrEngine-Ubuntu-18.04-2.1.1.deb to install on your PC.

4. Install the software on your PC following the “How to Install” instructions.

5. Initiate the PC’s Command Prompt utility as shown in the following figure, and enter CMD to open up a Command Prompt window.
6. Start the wrnch CaptureStream command line client by entering your unique key license* as follows:

    capturestream-cli -k <key license>

* If you do not yet have a license, visit License Types for more information.

This loads wrnch Engine 2.x which runs AI algorithms against a live video feed to track key skeletal joints (body, hands, wrist and face) to infer 3D human motion.
Setup the performance area and calibrate wrnch CaptureStream

1. Choose a well-lit, clear space where an actor will perform the human that you want to mimic in your Omniverse application. Consider a size about 10 feet x 10 feet, or 3m x 3m.

2. Mount the Webcam in landscape orientation in a fixed position, for example top of the computer. The Webcam needs to stay still as you capture the performance area where the actor will move. Ensure that the Webcam is far enough away from the performance space to ensure that you can capture the whole body of the actor.

3. To display what the Webcam is viewing on the computer screen, enter the following command to display a visualization window with AI pose metadata imposed on top of the actor:

   capturestream-cli -k <key license> -v
4. Print out approximately 6 AR marker sheets and place them on the floor to distinguish the performance area.

5. To calibrate the ground plane, from the capturestream -cli, press (g). As the color shifts from blue to green, calibration is complete. Press (g) to cancel.
6. To calibrate the human pose, ask the actor to hold an T-pose (arms out at an angle to each side while standing straight) while facing the camera. From the capturestream - client, press (t).

When the CaptureStream client has calibrated the body size, it turns green as shown in the following image.
Now you can track a person’s movement as the actor moves around the performance space.

At this point, the CaptureStream CLI is ready to stream 3D poses of the actor’s performance across your local network to a wrnch receiving application such as wrnch ReceiveVisualize for UE4, wrnch ReceiveVisualize for Unity, or wrnch AI Pose Estimator extension for NVIDIA Omniverse.

Set Up wrnch AI Pose Estimator extension for Omniverse

The wrnch AI Pose Estimator extension allows you to see devices running the wrnch CaptureStream application on your local network. Once you connect to an app and select the character you want to animate, the extension is ready to receive streaming pose data.

Launch NVIDIA Omniverse Machinima

1. Launch NVIDIA Omniverse Machinima.
2. Load a scene to which you want to add characters, materials etc.
3. Load the characters you want to animate in your story. For example, the following image shows three different character sets: Sol, GenericRig, and Squad being uploaded.

Select and set up the wrnch AI Pose Estimator extension
1. Select the wrnch AI Pose Estimator extension. The extension’s icon looks like this:

2. Enable the wrnch AI Pose Estimator extension by clicking the toggle switch as shown. The red light indicates that further setup is needed. You can dock the pop-up anywhere you’d like in the Omniverse app.
3. Select “Click here to get what you need to wrnch it” to view documentation.
4. In the CaptureStream source field, press the down-arrow to find and select the application streaming pose data across the local area network. If you do not see any applications listed, ensure that you have setup and started wrnch CaptureStream as described in “Set Up wrnch CaptureStream”.

**Note:** You also need to make sure your Omniverse application has local network access rights - this is controlled by Windows Firewall and can be verified by navigating in the Windows system to **Windows Defender Firewall -> Allow an app or feature through Windows Defender Firewall**, locating the Omniverse app, and making sure it has local network access.
5. Choose the skeleton you want to drive by clicking on the character in the scene (for example, the Sol character as highlighted in yellow in the following figure) and then selecting “Use highlighted skeleton”.
At this point, the wrnch setup indicator turns green, which means that the extension can start receiving AI pose data streaming from a camera in real-time.

Stream AI Pose Data to Animate 3D Characters in Real Time

Once everything is set-up, you will use both the wrnch CaptureStream application and the wrnch AI Pose Estimator extension to stream human pose metadata from a camera to animate 3D characters in an Omniverse application.

1. Within the wrnch AI Pose Estimator extension, press the “Start streaming motion” when you are ready to capture an actor’s human performance.
2. Using the wrnch CaptureStream application, begin capturing the actor’s performance that you’d like to reproduce in the Omniverse application. Within the CaptureStream application, the wrnch Engine is running AI algorithms against the live video feed. The human pose estimation algorithms track key skeletal joints to infer 3D human motion. Then the wrnch Engine outputs human pose metadata using the wrnch eXchange (wrX) data protocol across the local area network to the wrnch AI Pose Estimator extension in Omniverse in real time.

3. Within Omniverse, you will see your selected animated character mimic the movements of the human actor being recorded.
4. If necessary, you can adjust the “Height Offset” slider to align the character’s feet with the ground within your scene. When you have finished, press “Stop Streaming Motion”.

For additional information about the wrnch AI platform, including the wrnch Engine, wrnch CaptureStream, and wrnch extensions for Omniverse, Unreal Engine 4, or Unity, visit www.wrnch.ai.